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2018 APR -2 P 4: 48

TEP
Tucson Electric Power
88 East Broadway Blvd., P.O. Box 711
Tucson, Arizona 85702

April 2, 2018

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

Re: Notice of Filing – Tucson Electric Power Company's REST Compliance Report for the year ended 2017, Docket No. E-00000R-16-0084

Pursuant to Arizona Administrative Code R14-2-1812, each Affected Utility shall file with Docket Control a report that describes its compliance with the requirements of the Renewable Energy Standard and Tariff ("REST") Rules. Tucson Electric Power herby files its REST Compliance Report for year-end 2017.

Because the Report contains confidential information, such information has been redacted from this filing. The un-redacted Report is being provided directly to Staff pursuant to the terms of the Protective Agreement executed in Docket No. E-00000R-16-0084.

If you have any questions, please do not hesitate to contact me at (520) 884-3680.

Sincerely,

Melissa Morales
Regulatory Services

Arizona Corporation Commission
DOCKETED
APR 2 2018
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TEP
Tucson Electric Power

Response to R14-2-1812 Utility Reporting Requirements
of the
Arizona Corporation Commission

COMPLIANCE REPORT AND RENEWABLE ENERGY DATA FOR 2017

Tucson Electric Power Co. | PO Box 711, Tucson, AZ 85702

Table of Contents

Executive Summary

Compliance with 2017 Renewable Energy Standard ("RES") Requirements

For the calendar year 2017, the Arizona Corporation Commission ("ACC" or "Commission") established an annual RES requirement of 7.0 percent[1] of the utility's 2017 retail kilowatt-hour ("kWh") sales, with 30 percent[2] of the total requirement to be fulfilled with energy produced from Distributed Renewable Energy ("DRE") Resources. This separate DRE carve-out provision requires that one-half[3] of the total DRE requirement come from residential resources and one-half from non-residential resources. For the purposes of RES compliance tracking, Arizona Administrative Code ("A.A.C.") R14-2-1801(N) defines a Renewable Energy Credit ("REC") as the unit created to track kWh derived from a DRE or kWh equivalent of conventional energy resources displaced by a DRE; however, throughout this compliance report, Tucson Electric Power Company ("TEP" or "Company") discloses its production in both kWh and RECs.

In 2017, the Company's total Eligible Renewable Energy Resources, including Annualized Production and In-Progress projects, was 928,908,174 kWh, which is equivalent to 10.4 percent of TEP's total 2017 retail sales. Additionally, TEP reports the non-eligible renewable energy resources on its system which, when combined with the total eligible renewable energy resources for illustrative purposes only, equals 1,138,850,382 kWh and 12.7 percent of 2017 retail sales. Total DRE resources for the year was 216,253,455 kWh. Total Residential actual production was 73.8% of the 2017 residential requirement, and Non-Residential actual production was 156.9% of the 2017 non-residential requirement. TEP will retire 624,815,240 RECs for 2017 (Actual production of Residential DRE of 69,178,952; Non-Residential DRE of 147,074,503; and Non-DRE of 408,561,785).

The Company requested a waiver for 2016 & 2017 to the residential DRE requirement in its 2016 RES Implementation Plan, which was subsequently approved in Decision No. 75560. As shown in Table 1b, the annual residential DRE compliance measure required the retirement of 93,722,286; however, the Company only has the rights to retire 69,178,952 residential DRE RECs. However, consistent with Decision No. 74882 and the associated changes to the Arizona RES to acknowledge all renewable resources within the Company's service territory, the Company will use the waiver based on the production values shown in Table 1a for the total non-incentivized DRE production which aren't included in the RECs available for retirement.

[1] A.A.C. R14-2-1804(B)
[2] A.A.C. R14-2-1805(B)
[3] A.A.C. R14-2-1805(D)

Company's Eligible Renewable Energy Resources

Table 1a shows the following information:

1. Actual energy production[4]
2. Annualized energy production[5]
3. Generation capacity, disaggregated by technology type[6]

Compliance Report - Energy — **Tucson Electric Power Company**

Table 1a-Renewable Resources

Resource	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production Actual or Annualized[2] kWh	Multiplier Credits[3]	Total kWh or Equivalent
GENERATION									
UTILITY OWNED:									
Springerville 1	2001-2004	Fixed Tilt	TEP	3.68	4.60	1,564,166	1,564,166	1.5	2,346,249
Springerville 2	2010	Fixed Tilt	TEP	1.45	1.81	3,969,746	3,969,746	1.0	3,969,746
White Mountain	2014	Fixed Tilt/LCPV	TEP	8.25	10.00	16,799,284	16,799,284	1.0	16,799,284
U of A Tech Park 1	2010	Single Axis	TEP	1.28	1.60	2,851,549	2,851,549	1.0	2,851,549
U of A Tech Park 2	2011	Fixed Tilt	TEP	4.00	5.00	8,595,651	8,595,651	1.0	8,595,651
Headquarters	2012	Fixed Tilt	TEP	0.04	0.05	21,594	21,594	1.0	21,594
Warehouse OH	2012	Fixed Tilt	TEP	0.40	0.50	1,005,672	1,005,672	1.0	1,005,672
Prairie Fire	2012	Fixed Tilt	TEP	4.00	5.00	9,036,453	9,036,453	1.0	9,036,453
Demoss-Petrie	2001	Fixed Tilt	TEP	0.18	0.22	12,272	12,272	1.0	12,272
Sundt Augmentation	2014	Solar Steam Augmentation	TEP	5.00		2,767,300	2,767,300	1.0	2,767,300
Total Utility Owned				28.28	28.78	46,623,686	46,623,686		47,405,769
Purchase Power Agreements (PPAs):									
Aminox UASTP	2011	Dual Axis	PPA	1.20	2.00	452,432	452,432	1.0	452,432
Gatos Montes	2012	Fixed Axis	PPA	4.92	6.00	9,666,618	9,666,618	1.0	9,666,618
Avra Valley	2012	Single Axis	PPA	25.00	34.41	73,724,798	73,724,798	1.0	73,724,798
Picture Rocks	2012	Single Axis	PPA	20.00	25.00	53,977,470	53,977,470	1.0	53,977,470
E. ON Tech Park	2012	Single Axis	PPA	4.80	6.60	12,994,470	12,994,470	1.0	12,994,470
Valencia Solar	2013	Single Axis	PPA	10.00	13.20	26,410,574	26,410,574	1.0	26,410,574
Macho Springs	2011	Wind	PPA	50.40		126,435,000	126,435,000	1.0	126,435,000
Avalon Solar	2014	Single Axis	PPA	28.34	35.00	78,228,496	78,228,496	1.0	78,228,496
Cogenra	2014	CPV Single Axis	PPA	1.10	1.38	1,662,817	1,662,817	1.0	1,662,817
Red Horse Solar	2015	Single Axis	PPA	41.00	51.25	151,532,100	151,532,100	1.0	151,532,100
Red Horse Wind	2015	Wind	PPA	30.00		62,518,730	62,518,730	1.0	62,518,730
Avalon PHII	2015	Single Axis	PPA	17.22	21.53	44,300,941	44,300,941	1.0	44,300,941
Los Reales Landfill	1998	Biomass	PPA	4.00		24,473,769	24,473,769	1.5	36,710,654
Iron Horse	2017	Single Axis	PPA	2.04	2.40	3,585,538	3,585,538	1.5	5,378,307
Manufacturing Credit		PV	Global Solar				0	1.0	0
Total PPAs				240.02	198.77	669,963,754	669,963,754		683,993,407
Gross Total				268.30	227.55	716,587,440	716,587,440		731,399,177
Adjustment of 10% wholesale DG applied to Non-Residential Requirement						(18,744,457)	(18,744,457)		(18,744,457)
Total Production of AC & DC Facilities						697,842,983	697,842,983		712,654,719 A
Subtotal Capacity of AC Facilities				84.40					
Subtotal Capacity of DC Facilities Including AC Equivalent				183.90	227.55				
Total AC Generation Capacity (excl. Credits)				268.30		756,225,946			

[4] As required by A.A.C. R-14-2-1812(B)(1)
[5] As required by A.A.C. R-14-2-1812(B)(2)
[6] As required by A.A.C. R-14-2-1812(B)(3)

Table 1a continued.

DISTRIBUTED ENERGY (DRE)	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production Actual or Annualized[1] kWh	Multiplier Credits[3]	Total kWh or Equivalent	
RESIDENTIAL:										
Incentive										
Installed										
Purchase		PV	Owned		17.57					
Lease		PV	Leased		14.46					
Total-PV Incentive					32.03	58,739,177	58,739,177	1.0	58,739,177	
Thermal		Thermal	Owned			6,740,250	6,740,250	1.0	6,740,250	
Total-Thermal						6,740,250	6,740,250		6,740,250	
Utility Owned:										
Installed					2.68	3,699,525	3,699,525	1.0	3,699,525	
In Progress					0			1.0	0	
Total-PV Utility Owned		PV	Utility Owned		2.68	3,699,525	3,699,525		3,699,525	
Subtotal of Installed Residential Incentive & Utility Owned Production						69,178,952	69,178,952		69,178,952	B
Subtotal Capacity of DC Facilities Including AC Equivalent				29.91	37.39					
Total AC Generation Capacity (excl. Credits)				29.91						

RESIDENTIAL:										
Non-Incentive										
Installed										
Purchase		PV	Customer Owned		30.04					
Lease		PV	Leased		59.36					
Total-PV Installed					89.4	121,197,203	121,197,203		121,197,203	
In Progress										
Purchase		PV	Customer Owned		4.37					
Lease		PV	Leased		2.51					
Total-PV In-Progress					6.88		12,384,000		12,384,000	
Subtotal Non-Incentive Installed & In Progress						121,197,203	133,581,203		133,581,203	H
Subtotal Capacity of DC Facilities Including AC Equivalent				77.02	96.28					

DISTRIBUTED ENERGY (DRE)	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production Actual or Annualized[2] kWh	Multiplier Credits[3]	Total kWh or Equivalent	
Non-RESIDENTIAL:										
Up-Front Incentive										
Installed										
Purchase		PV	Owned		4.30					
Lease		PV	Leased		1.39					
Total-PV UFI				4.55	5.69	7,700,587	7,700,587	1.0	7,700,587	
Thermal		Thermal	Owned			4,670,985	4,670,985	1.0	4,670,985	
Wind		Wind	Owned	0.01		4,659	4,659	1.0	4,659	
Daylighting		Daylighting	Owned			188,539	188,539	1.0	188,539	
Total-Up-Front Incentive				4.56	5.69	12,564,770	12,564,770		12,564,770	
Performance Based Incentives:										
PV		PV	Owned		41.33	74,037,763	74,037,763	1.0	74,037,763	
Chilling		Chilling	Owned			1,883,822	1,883,822	1.0	1,883,822	
Total-PBI				33.06	41.33	75,921,585	75,921,585		75,921,585	
Utility Owned:										
Fort Huachuca	2014	Fixed Axis	Utility Owned	13.60	17.20	30,521,649	30,521,649	1.0	30,521,649	
Fort Huachuca II	2017	Fixed Axis	Utility Owned	4.40	5.00	9,116,857	9,116,857	1.0	9,116,857	
Subtotal of Installed Non-Residential Incentive & Utility Owned Production						128,124,861	128,124,861		128,124,861	
Subtotal Capacity of DC Facilities Including AC Equivalent				55.63	69.22					
Total AC Generation Capacity				55.63						

Credits										
Wholesale (10% of DG Req)						18,744,457	18,744,457		18,744,457	
Subtotal After Wholesale Credit						146,869,319	146,869,319		146,869,319	
Residential Credits										
In-State Manufacturing and Installation Content						38,992			38,992	
In-State Plant Installation Credit						83,096			83,096	
Distributed Generation Credit						83,096			83,096	
Subtotal After Residential Credits						147,074,503			147,074,503	C

Continuation of Non-Residential, summations, and notes on following page.

Table 1a continued.

Non-Incentive / Non-Residential: DISTRIBUTED ENERGY (DRE)	Install Year	Technology	Ownership	MW(AC)	MW(DC)	Production (Actual) kWh	Production Actual or Annualized[2] kWh	Multiplier Credits[3]	Total kWh or Equivalent	
Non-Incentive										
Installed										
Purchase		PV	Owned		49.77					
Lease		PV	Leased		7.99					
Total-PV Installed					57.76	67,811,005	67,811,005		67,811,005	
In-Progress										
Purchase		PV	Owned		2.39					
Lease		PV	Leased		2.36					
Total-PV In-Progress					4.75		8,550,000		8,550,000	
Subtotal DE - Non-Residential Installed & In-Progress						67,811,005	76,361,005		76,361,005	I
Subtotal Capacity of DC Facilities Including AC Equivalent				50.01	62.51					

Summary & Notes:	MW(AC)	MW(DC)	Production (Actual) kWh	Production Actual or Annualized[2] kWh	Total kWh or Equivalent	
Subtotal Distributed Energy - Incentive (B + C)	85.54	106.61	216,253,455	216,048,271	216,253,455	D
Subtotal Distributed Energy - Non-Incentive Installed & In-Progress (H + I)	127.03	158.79			209,942,208	E
Total RES Resources Available for Compliance (A + D)	85.54	106.61	914,096,438	913,891,254	928,908,174	F
Total 2017 RES Resources Available for Retirement[4]					914,096,438	G
Total AC Capacity & AC Equivalent[2]	353.84					

Notes to Table 1a:

[1] Assumes the following kWh per installed kW:

Residential and Non-Residential: 1800 kWh/kW (based on average systems installed)
Residential Utility Owned : 1900 kwh/kW (newer technology installed)
Utility Generation, Fixed Tilt: 2000 kWh/kW
Utility Generation, Single-Axis Tracker: 2200 kWh/kW
Utility Generation, Dual-Axis Tracker: 2400 kWh/kW
Utility Generation, Wind: 2200 kWh/kW

[2] The Mwac equivalent is the summation of the Utility Owned MW(AC) value plus the DG DC capacity converted from DC to AC using an 80% DC-AC conversion factor.

[3] Manufacturing Credit Multiplier 2,190.0

In-State Power Plant Extra Credit (1997-2005) 0.5
In-State Manufacturing and Installation Content (1997-2005) 0.5 X (% in-state content in installed plant)
DRE Solar Electric Generator and Solar Incentive Program (1997-2005) 0.5

[4] Does not include Annualized Production or In-Progress

Renewable Energy Credit Retirement Summary

Table 1b shows the breakdown of RECs used to satisfy both the annual renewable energy requirement and the DRE requirement[7].

Tucson Electric Power

Table 1b - Compliance Summary

			Compliance Measure (kWh)		Available RECs for Retirement		Carry Forward
Retail Sales	Actual kWh Sales for 2017		**8,925,932,000**				
2016 Carry Forward Balance							
Non-DRE Balance					991,518,226		991,518,226
Total RES Requirement	% of Retail Sales	7%	**624,815,240**	a			
DRE Requirement	% of RES Requirement	30%	**187,444,572**				
Residential DRE	% of DRE Requirement	50%	**93,722,286**		69,178,952	b	
Non-Residential DRE	% of DRE Requirement	50%	**93,722,286**		147,074,502	c	
Non-DRE	Non-DRE Requirement						
	Total RES Requirement (a)		**408,561,786**		697,842,983		289,281,197
	- Residential RECs (b)						
	- Non-Residential RECs (c)						
Total Resources Available for the 2017 REC Retirement					**1,905,614,663**		
Total Retirement					**624,815,240**		
Residential DRE					69,178,952		
Non-Residential DRE					147,074,502		
Non-DRE					408,561,786		
Total 2017 Carry Forward Balance							1,280,799,423

[7] As required by A.A.C. R14-2-1812(B)(5)

Renewable Energy Standard Incentive Costs

Table 2b shows cost information regarding \$/MWh of energy obtained from eligible renewable energy resources and \$/MW of generation capacity, by technology, that can be attributed to the RES[9] for third-party projects receiving incentives.

Table 2b - RES Cash Incentive Costs **Tucson Electric Power Company**

2017 Distributed Energy Cash Incentive Program Costs

	MW	MWh	Production Based Incentives ($/MW)	($MWh)	2017
Non-Residential:					
PBI					
PV					
PBI Legacy					
PV		74,038		$ 97.88	$ 7,246,830
Solar Chilling		1,883		120.53	226,997
Subtotal: Non-Residential		75,921			$ 7,473,827

Notes to Table:

[1] Based on expected annual system production.

ACC Approved Budget

[9] As required by A.A.C. R14-2-1812(B)(4)

Tucson Electric Power
ACC Budget
January through December 2017

	Jan - Dec 17
Revenue	
Tariff Billing	$ 52,019,444
Carryforward from Previous Year	1,405,878
Total Revenue	53,425,322
Expenses	
Purchased Renewable Energy	
AMCCCG	41,041,220
TEP Owned	
Depreciation	600,000
Maintenance	66,000
Property Tax Expense	0
Return on Investment	424,123
TEP Owned	1,090,123
Total Purchased Renewable Energy	42,131,343
Customer Sited DG	
Consumer Education and Outreach	100,000
Meter Reading	37,131
Production Based Incentive Payment	7,192,720
Total Customer Sited DG	7,329,851
Technical Training	95,000
Information Systems	
Other IT	
Information Systems - Other	
Information Systems	84,000
Metering	
Metering Other	960,560
Metering	960,560
Labor & Administration	
Internal Labor	217,568
External Labor	163,000
Materials, Fees & Supplies	60,000
AZ Solar Website	4,000
Total Labor & Administration	444,568
Research & Development	
Membership Dues	15,000
Grid Study	240,000
DOE Grant Monies	1,750,000
Modeling/Simulation DER Hosting Capacity	200,000
University Support	175,000
Research & Development	2,380,000
Total Expenses	53,425,322
Net Revenue	$ -

RES Revenue Expenses

Tucson Electric Power
Net Revenue (Expenses)
January through December 2017

		Jan - Dec 17
Revenue		
Tariff Billing	$	49,328,345
Liquidated Damages		-
Total Revenue		49,328,345
Expenses		
Purchased Renewable Energy		
AMCCCG		43,670,763
Other Purchased Power		98,066
TEP Owned		
Property Taxes		-
Depreciation		1,111,204
Maintenance		24,152
Return on Investment		968,632
Total TEP Owned		2,103,989
Total Purchased Renewable Energy		45,872,819
Customer Sited DG		
Consumer Education and Outreach		90,613
Production Based Incentive Payment		7,473,827
Total Customer Sited DG		7,564,440
Technical Training		91,885
Information Systems		83,999
Metering		728,863
Labor & Administration		
Internal Labor		286,351
External Labor		7,790
Materials, Fees & Supplies		59,940
AZ Solar Website		2,965
Total Labor & Administration		357,046
Research & Development		
Dues & Fees		15,000
Grid Study		237,112
DOE Grant Monies		1,721,170
Modeling/Simulation DER Hosting Capacity		195,090
University Support		175,000
Research & Development		2,343,372
Total Expenses		57,042,424
TOTAL NET REVENUE (EXPENSES)	$	(7,714,079)
Carry forward from Prior Year		1,405,878
Loss Carry forward to 2019	$	(6,308,201)

Budget Variance Report

Below is a description of the budget variances that were realized between the 2017 ACC approved budget, shown on page 10, and the RES program actual expenses, shown on page 11.

The total expenses in 2017 of $57,431,720 exceeded the revenue of $49,328,345 by $7,714,079. After applying the carry forward from 2015 of $1,405,878 this leaves a balance of $(6,308,201) of net expenses to carry forward to TEP's 2018 Implementation Plan.

Tariff Revenue

- The delay in new rates and new tariff caps until March of 2017, resulted in a $2.7 million dollar loss in tariff revenue.

Above Market Cost of Comparable Conventional Generation ("AMCCCG"):

- Favorable weather throughout 2017 created a higher production value for TEP's PPAs, thus increasing the AMCCCG expense by $2.7 million.

TEP-Owned:

- Due to the delay in the TEP rate case, the Ft. Huachuca Phase I, HQ Rooftop, White Mountain, and Areva projects were not moved from the TEP REST budget into TEP's base rates until February 27, 2017.
- Depreciation, Maintenance, and Return on Investment for these four Utility-Scale projects were funded out of the RES budget instead from TEP's base rates. This resulted in an increased expense of $2.7 million.

Performance-Based Incentives:

- The Company requested a lower PBI budget to account for the over-collection of payments in prior years due to delays in projects being completed. In addition, favorable weather led to increased production for these projects.

TEP-Owned Residential Solar Discussion

In the Company's 2015 REST Implementation Plan, the ACC approved the TEP-Owned Residential Solar ("TORS") Program. Per Commission order (Decision No. 74884), the overall program costs were capped at $10 million and TEP has limited the size of the Program to a maximum of 600 residential customers. In the Company's 2016 REST Implementation Plan, the ACC did not approve a request by the Company to continue and expand the program (Decision No. 75815). As discussed in the Company's *Compliance Report and Renewable Energy Data for 2015* filed in ACC Docket E-00000R-16-0084 on April 1st, 2016, the Company began publically accepting applications for the TORS program on July 1st, 2015, with the corresponding installations occurring soon after. TORS applications and solar photovoltaic ("PV") installations continued throughout 2016 & 2017. The Company has brought the TORS Program to an end within the constraints initially established by the preliminary approval. The following discussion provides an overview of where the program reached in conclusion of its subscription and deployment.

Contracts, Installations and Customers

Executed Contracts: The Company processed and executed all customer contracts by the end of 2016. In total, the TORS program contains 477 executed contracts, for a cumulative capacity of 2.68 MW DC. Due to extenuating circumstances of both customers and installers, the Company did allow for nine customer contracts to be executed in 2017.

Commissioned Installations: The Company has continued to rely on the three local solar installation partners, originally selected in late 2014, during the program's implementation. These companies were Technicians for Sustainability ("TFS"), Custom Solar and Leisure, and Solar Solution AZ. The Company completed the remaining installations by the end of October 2017.

Customer Usage: As part of the TORS program, and in agreement with participating customers, TEP reviews the usage of each participant annually and compares that amount for the most recent calendar year to the contracted usage. Customers that have kept their annual usage within the 85% to 115% allowances see no changes in their TORS payment or contracted usage amount. For customers that had an annual usage below 85% or above 115% of their contracted amount will have their contracted amount reset to coincide with their average, on a going-forward basis.

In January of 2018, TEP reviewed the 2017 usage for 374 TORS customers. This review resulted in 112 customers having their fixed monthly payment adjusted: 33 customers used less than 85% of their contracted usage and their fixed monthly payment was decreased; 79 customers used more than 115% of their contracted usage and their monthly payment was increased. The remaining 262 customers had recent annual usage within the approved range and were not adjusted. These customers used approximately 3% more kilowatt hours in 2017 compared to their contracted usage.

Due to being placed on the TORS rate at some point in 2017, 103 TORS customers did not have a complete calendar year of usage in the program and were not reviewed. These customers will be part of the annual review that next takes place in January 2019 and reviews 2018 customer usage.

Usage	# of Customers	Overall %
>115%	79	17%
Within Contracted Range	262	55%
<85%	33	7%
Not Reviewed	103	22%
Total	477	

Budget and Inventory

Program Budget: The budget for the TORS program consisted primarily of two main expense types: material and labor. The vast majority of the TORS material expense was attributed to PV modules and grid-tied inverters that were purchased in 2015 and allocated to the installers on a per-project basis. The labor expense is comprised of payments made to the solar installation partners as they completed and commissioned PV systems. In total, TEP concluded the TORS program having spent $6.8 million of the approved $10.0 million budget. This total expense is split nearly equally between materials and labor, resulting in an overall installed cost of $2.24/watt.

Remaining Inventory: At the onset of the project, TEP secured enough inventory for all 600 potential projects. Since only 477 were installed, the Company still has the remaining PV modules and inverters in inventory. This inventory has not been expensed to the overall program, so it does not affect the total budget spend referenced above. The Company is in process of looking for opportunities to utilize the remaining material in future projects, while also keeping an appropriate amount in reserves to be used as spares for existing TORS projects.

Fleet Characteristics, Performance and Maintenance

Fleet Characteristics: The Company established system design criteria for TORS installation partners that biased PV system orientations and designs towards the west. This was done in an effort to maximize solar PV production in the later afternoon hours of the day, where it is more beneficial to the Company's system peak.

Installation partners were able to design systems with an orientation within the range of 135 degrees (45 east of south) and 290 degrees (20 degrees north of west). In order to bias towards summer production, system orientations were required to have a module tilt angle of between 10 and 25 degrees from horizontal. If multiple orientations within the required range were available, system designs prioritized the most westerly orientation. The 2.68 MW DC TORS Fleet has a weighted average orientation of 220-degree azimuth and a 19-degree tilt.

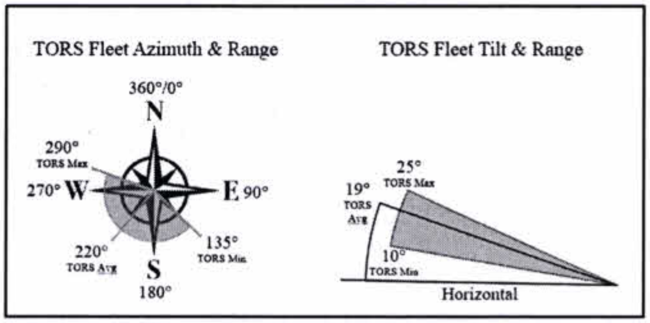

Figure 1: TORS Fleet Orientation

The TORS fleet orientation resulted in a maximum production shift of two hours into the afternoon when compared to a PV system with an orientation facing due south (180 degrees).

Fleet Performance: The TORS fleet of 2.68 MW DC is performing at 94.4% of the expected level of production. The TORS rate was based on a system that would produce 1,900 kWh/yr/kW DC if it was oriented to maximize annual production – south facing at 25° tilt. With the TORS orientation, it would be anticipated that the fleet would produce 1,800 kWh/yr/kW DC. TORS fleet production is currently at ~1,700 kWh/yr/kW DC. The difference between the expected production and the actual production can be primarily attributed to fleet maintenance issues.

Fleet Maintenance: TEP monitors the TORS fleet performance with a daily production report. The production reports indicate that TEP experiences system operation issues on ~3% of the systems. This is due primarily to inverter firmware upgrade issues that are currently being resolved. It may also be due to limited amounts of general equipment failure and blown fuses. TEP addresses maintenance issues with a hybrid approach of either TEP personnel or installation partners, depending on the nature of the issue.

Technical Pursuits

Research and Development: Per Commission Order (Decision No. 76024) the Company initiated a research project in 2017 focused on grid modernization that includes some of the TORS fleet. The research project will be aimed at exploring the utilization of TORS grid-tied inverters in coordination with other Distributed Energy Resources ("DERs") using a Distributed Energy Resource Management System ("DERMS"). The Company will be partnering with top-tier industry representatives from manufacturing and national labs to inform and validate the projects. The Company expects to have technical reports outlining research objectives and results available in mid-2018.

Solar Resources for Distribution Optimization Discussion

As part of Decision No. 76024, TEP was granted matching funds of up to $1,750,000 for the potential participation in a Department of Energy's ("DOE") Enabling Extreme Real-Time Grid Integration of Solar Energy ("ENERGISE") funding program. The overall scope of that funding submittal was presented in the Company's 2017 Implementation Plan. As part of the Decision, a full update was to be submitted in TEP's 2017 REST Annual Compliance Filing.

In June 2017, TEP was informed that the overall submittal from TEP and its applicant partners did not receive an award, therefore the overall project was essentially null and void. However, as part of Decision No. 76024, the Commission and Commission Staff believed it was still in the best interest of the Company to conduct a pared-down version of the study.

In the 3rd quarter of 2017, TEP engaged with the Electric Power Research Institute ("EPRI") to conduct this study. The decision to use EPRI was largely due to the success that Arizona Public Service ("APS") had with them on their Solar Partner Program ("SPP"). The Company believed that EPRI could use knowledge gained from the SPP program to further enhance its own research. The research is expected to last roughly 18 months.

The overall project budget was collected in the 2017 budget, and will be allocated for its specific use in 2018 and 2019. No new project funding was requested in 2018, and is not expected in 2019. Upon project completion, any remaining budget will be trued-up in the next available REST Implementation Plan.

Below is a full update of the scope of the project, research questions, methods, project plan, and schedule.

Project RAIN – Resource Aggregation and Integration Network

Executive Summary

TEP and EPRI are working to explore new technologies for coordinating distributed energy resources ("DER") for maximum benefit. This project, scheduled for 2018 and the first half of 2019, investigates:

- the state of the industry with respect to DER aggregation,
- the real-world capabilities of individual DER as well as groups,
- potential for customer engagement in supporting the grid,
- practical challenges of communication and coordination, and
- future strategies for applying DER management to TEP grid operations.

Expanding on recent demonstrations of individual technologies, such as smart inverters and battery storage, Project RAIN – Resource Aggregation and Integration Network - is one of the first globally to explore how generation might be combined with flexible loads (such as electric vehicle chargers or smart thermostats) to create optimal responses to system needs. Open standards and protocols (such as Sunspec Modbus and OpenADR) will be featured in an effort to improve future system performance and reduce integration costs.

TEP and EPRI have created a set of research questions to guide the project, which will require a combination of laboratory and field evaluation to fully investigate. Several controller vendors (both established and new entrants) will be engaged as part of the process, culminating in a field evaluation of a single control system coordinating DER from multiple suppliers.

Understanding and implementing these capabilities will involve a multi-disciplinary team at TEP, bringing together staff from renewable generation, customer programs, distribution planning and operations, information technology, and cybersecurity.

Background

With tremendous growth in DER such as solar photovoltaics ("PV"), battery storage, and responsive end-use devices comes new challenges for the electric distribution system – but also new opportunities. Cost-effective strategies for managing the realities of DER growth will likely go beyond wires-only solutions. Harnessing the capabilities of DER to provide voltage support, fault response, congestion relief, and situational awareness allows for increased hosting capacity as well as improvements in the reliability, safety, efficiency, and affordability of the future grid.

The distributed energy resource management system ("DERMS") is a rapidly evolving technology designed to address the need to coordinate many different DER systems together for greater grid benefit.

The role of the DERMS in the future power system is to:

- Translate commands between the various communication languages that DER may directly utilize
- Aggregate many distributed resources into a smaller set of control points addressable by the grid operator of distribution management system ("DMS")
- Simplify the many device-level parameters into a reduced set of instructions that are most meaningful to system operations

- Optimize the distribution of commands across the connected devices so that the requests are carried out fairly and efficiently

A simplified architecture diagram is shown in Figure 1. For this project the focus will be on the downstream organization and optimization (using direct input from an operator). Future work will be to demonstration connections with upstream utility enterprise systems, such as distribution management or customer information ("CIS") systems.

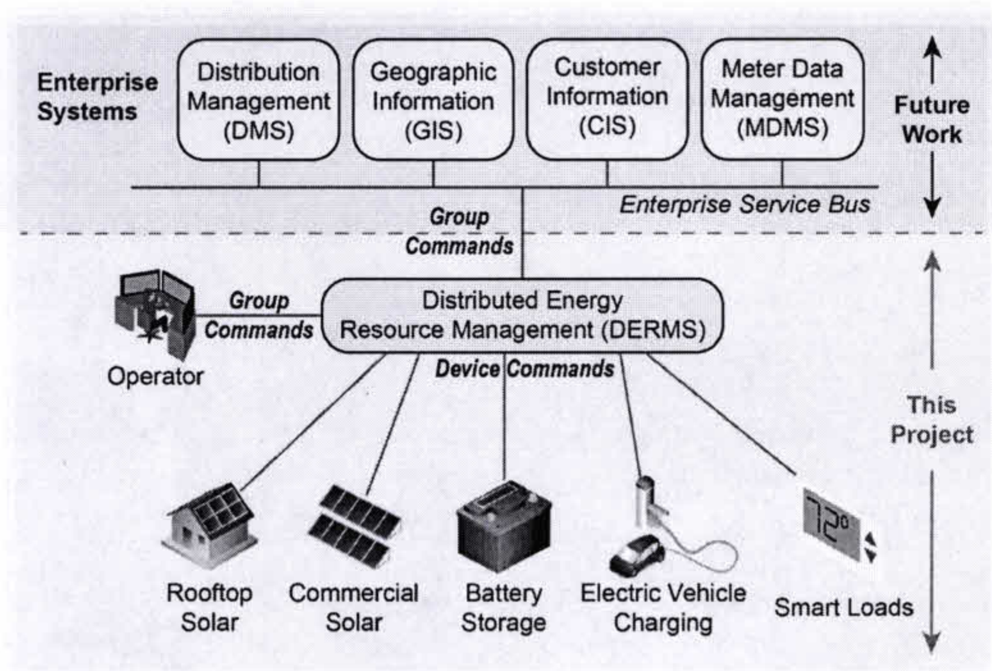

Figure 1
Simplified communication architecture showing the aggregation responsibilities of DERMS

Many vendors have created DERMS products (or products with DERMS-like functionality such as virtual power plants ["VPP"] or microgrid controllers). However, they've had limited opportunities to demonstrate these products in actual distribution systems, leaving their techniques unproven. A methodical examination of these issues is needed to identify gaps and opportunities for the next round of standards as well as developing more general guidance for utilities and vendors on the expectations and capabilities of DERMS as a tool for improved integration of DER.

Research Questions

TEP and EPRI staff identified nine research questions at the project outset that are intended to guide the experiment:

1. How interoperable are DERMS with downstream (DER) devices?
2. How are DERMS vendors addressing cybersecurity within their products?
3. How should different DER technologies be dispatched by DERMS in the field?
4. What is the impact of different approaches to grouping DER? (for example, by technology, size, or location)?
5. Are there advantages to centralized control over having distributed intelligence at the DER?

6. What are the bandwidth and throughput requirements for DERMS communication under various control strategies?
7. What is the impact of communication latency, intermittency, and/or bandwidth limitations on DERMS performance?
8. How might high-resolution data sources (such as synchrophasors) be utilized in DER and distribution system management?
9. What practical approaches to DERMS implementation are most beneficial to TEP customers, operators and enterprise systems?

Project Plan

Project RAIN currently consists of five major work activities, summarized in Figure 2:

- **Experimental design**, including identifying and procuring resources, developing test plans, requesting participation from DERMS vendors.
- **Laboratory testing** of candidate DERMS systems for basic interoperability and cybersecurity with downstream devices.
- **System integration** of a single selected DERMS with field devices via direct communication (Modbus) and business-to-business cloud communication (OpenADR).
- **Field testing** of the constructed system to investigate the accuracy of control, optimization methods, and customer impact.
- **Analysis and reporting** of research findings from laboratory and field testing. Outreach to the industry is planned through public reporting, advisory councils, and presentations at various industry forums.

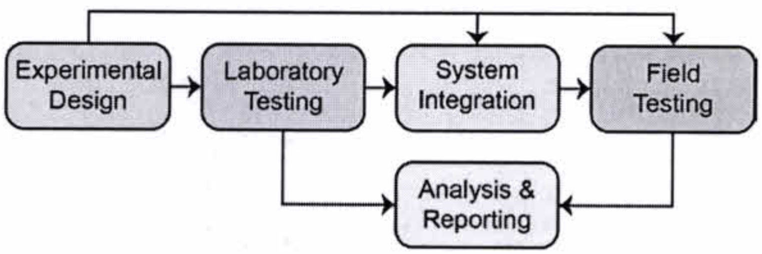

Figure 2
Project RAIN includes a combination of laboratory and field testing, supported by design, integration, and analysis.

Laboratory testing will be offered to interested DERMS vendors prior to the final selection of a candidate system for field evaluation. Laboratory evaluation will use EPRI- and industry-developed testing platforms to investigate interoperability at the protocol-level. A cybersecurity evaluation will also consider the implementation of industry best practices and the interfaces to downstream devices.

In order to evaluate the DERMS in the field, a network of controllable assets is planned to be installed and commissioned.

- **A 60kW PV array at TEP's headquarters building**. This system is already installed, but needs communications equipment retrofit, as well as power monitoring equipment.
- **Three electric vehicle chargers at TEP's garage building** – occupying pillars on existing spaces. These systems need to be procured, installed, and commissioned with associated power monitoring equipment.

- **Twelve participating TEP-owned Residential Solar (TORS) customers.** In addition to their PV array's (already installed) each customer would receive a combination of a programmable thermostat, battery storage device, or a grid-interactive water heater. The final install base will depend on the suitability of each residence and the availability of hardware that supports open communications.

Using a range of resources, the project team intends to create a balanced portfolio of DER for the selected DERMS to control. Figure 3 shows a breakdown of the currently projected DER installations by aggregate power level (% of total kWac).

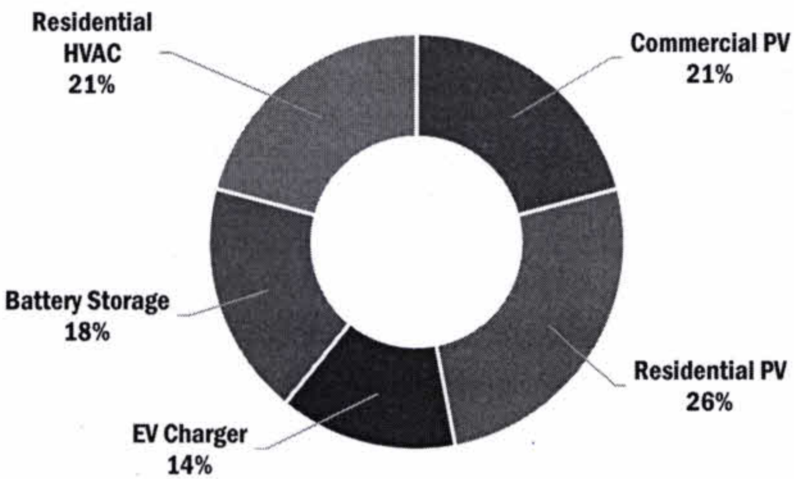

Figure 3
A balanced portfolio of DER helps understand the implications of optimization by the DERMS

Control signals to the individual DER will be routed by Modbus and OpenADR protocols as shown in Figure 4. EPRI-designed monitoring systems we also be deployed to record response for later analysis by the research team. Synchrophasor data from various points on the TEP system will also be transferred to EPRI to understand the impact of high DER concentration on the power system during faults or other transient conditions.

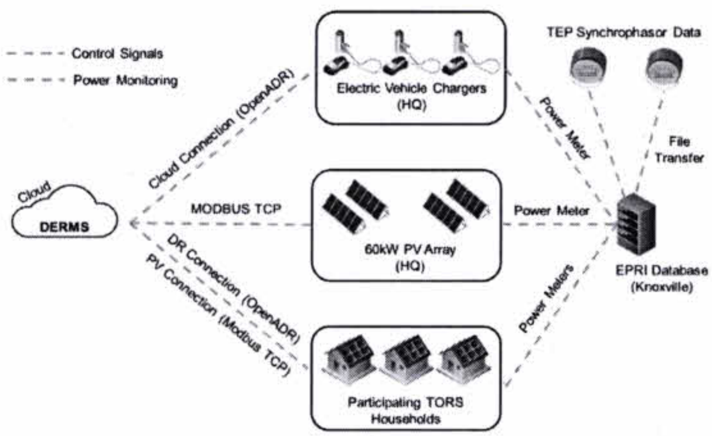

Figure 4
The DERMS will communicate with end devices over multiple protocols. Operations will be recorded by separate power meters at each location.

Project Schedule

The project schedule (Figure 5) is estimated at 18 months, running until the middle of 2019. Advisory councils are expected to be held following key milestones. Though the final reporting will be at the conclusion of the project, interim reports are also expected at key milestones.

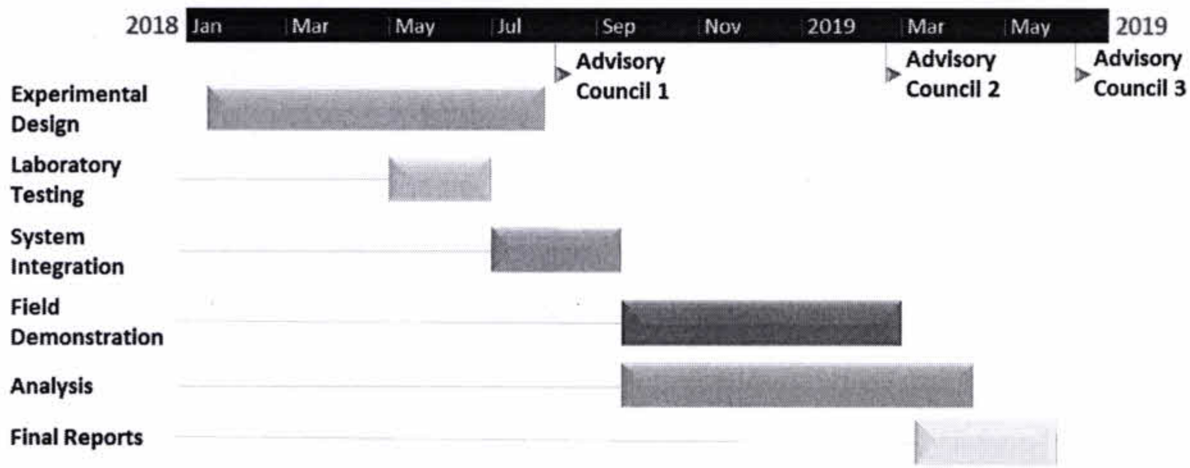

Figure 5
Project RAIN is expected to last approximately 18 months, until the middle of 2019.

Outreach

Several outreach opportunities are expected for Project RAIN's research findings, including:

- Summary reporting at key milestones, including a comprehensive final report
- TEP-organized advisory councils (similar to APS' SPP advisory councils)
- Appearances at relevant industry conferences